

DRAFT

Grade 5

Science

Item Specifications

Updated January 2021



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Grades 3-5 SCIENCE

Introduction

In 2014 Missouri legislators passed House Bill 1490, mandating the development of the Missouri Learning Expectations. In April of 2016, these Missouri Learning Expectations were adopted by the State Board of Education. Groups of Missouri educators from across the state collaborated to create the documents necessary to support the implementation of these expectations.

One of the documents developed is the item specification document, which includes all Missouri grade level/course expectations arranged by domains/strands. It defines what could be measured on a variety of assessments. The document serves as the foundation of the assessment development process.

Although teachers may use this document to provide clarity to the expectations, these specifications are intended for summative, benchmark, and large-scale assessment purposes.

Components of the item specifications include:

Expectation Unwrapped breaks down a list of clearly delineated content and skills the students are expected to know and be able to do upon mastery of the Expectation.

Depth of Knowledge (DOK) Ceiling indicates the highest level of cognitive complexity that would typically be assessed on a large scale assessment. The DOK ceiling is not intended to limit the complexity one might reach in classroom instruction.

Item Format indicates the types of test questions used in large scale assessment. For each expectation, the item format specifies the type best suited for that particular expectation.

Content Limits/Assessment Boundaries are parameters that item writers should consider when developing a large scale assessment. For example, some expectations should not be assessed on a large scale assessment but are better suited for local assessment.

Sample stems are examples that address the specific elements of each expectation and address varying DOK levels. The sample stems provided in this document are in no way intended to limit the depth and breadth of possible item stems. The expectation should be assessed in a variety of ways.

Possible Evidence indicates observable methods in which a student can show understanding of the expectations.

Stimulus Materials defines types of stimulus materials that can be used in the item stems.

Grades 3-5 SCIENCE

Physical Sciences		5.PS1.A.1
Core Idea	Matter and Its Interactions	
Component	Structure and Properties of Matter	
MLS	Develop a model to describe that matter is made of particles too small to be seen.	
<u>Expectation Unwrapped</u>		<u>DOK Ceiling</u> 3
<p>[Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.]</p> <p><u>SCIENCE AND ENGINEERING PRACTICES</u></p> <p>Developing and Using Models</p> <ul style="list-style-type: none"> Using models to describe phenomena <p><u>DISCIPLINARY CORE IDEAS</u></p> <p>Structure and Properties of Matter</p> <ul style="list-style-type: none"> Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. <p><u>CROSSCUTTING CONCEPTS</u></p> <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> Natural objects exist from the very small to the immensely large. 		<p><u>Item Format</u></p> <p>Selected Response Constructed Response Technology Enhanced</p>
<u>Content Limits/Assessment Boundaries</u>		<u>Sample Stems</u>
<ul style="list-style-type: none"> Tasks should not include the atomic-scale mechanisms of evaporation and condensation or the defining of the unseen particles. Students' descriptions should be limited to a written response. Pictorial descriptions would be possible as part of a technology enhanced item. 		<p>A group of students are on a trip and notice white crystals on some rocks along the beach. The white crystals look just like salt. The students collect some of the crystals, along with some pebbles and sand from the beach. They decide to test whether the properties of</p>

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Possible Evidence

- Students develop a model to describe a phenomenon (observable event) that includes the idea that matter is made of particles too small to be seen. In the model, students identify the relevant components for the phenomenon, including the following
 - Bulk matter (macroscopic observable matter [e.g., sugar, air, water])
 - Particles of matter that are too small to be seen
- In the model, students identify and describe relevant relationships between components, including the relationships between
 - bulk matter and tiny particles that cannot be seen (e.g., tiny particles of matter that cannot be seen make up bulk matter).
 - the behavior of a collection of many tiny particles of matter and observable phenomena involving bulk matter (e.g., an expanding balloon, evaporating liquids, substances that dissolve in solvents, effects of wind).
- Students use the model to describe how matter composed of tiny particles too small to be seen can account for observable phenomena (e.g., air inflating a basketball, ice melting into water).

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

the substances are similar to salt. The students know that salt dissolves, so they investigate by mixing the different substances into 50 milliliters of water. The students record the results of the five different tests in Table 1.

Table 1. Substances Mixed with 50 Milliliters of Water

Test	Substance	Mass	Results
1	salt from kitchen	10 grams	not visible
2	white crystals from beach	10 grams	not visible
3	rock salt from kitchen	10 grams	partly visible
4	sand from beach	10 grams	visible
5	pebbles from beach	10 grams	visible

1. After completing Test 1, the students cannot see any salt in the container. They are not sure if the salt is still there. They want to investigate the water to find out. Which investigation would show that salt is still in the container with the water?
2. Why could the students no longer see the substances that they mixed with the water in Tests 1 and 2?

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Physical Sciences		5.PS1.A.2
Core Idea	Matter and Its Interactions	
Component	Structure and Properties of Matter	
MLS	Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.	
<p align="center"><u>Expectation Unwrapped</u></p> <p>[Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.]</p> <p><u>SCIENCE AND ENGINEERING PRACTICES</u></p> <p>Using Mathematics and Computational Thinking</p> <ul style="list-style-type: none"> Measure and graph quantities such as weight to address scientific and engineering questions and problems. <p><u>DISCIPLINARY CORE IDEAS</u></p> <p>Structure and Properties of Matter</p> <ul style="list-style-type: none"> The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. <p>Chemical Reactions</p> <ul style="list-style-type: none"> No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.) <p><u>CROSSCUTTING CONCEPTS</u></p> <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. 		<p align="center"><u>DOK Ceiling</u></p> <p align="center">3</p> <p align="center"><u>Item Format</u></p> <p>Selected Response Constructed Response Technology Enhanced</p>
<p align="center"><u>Content Limits/Assessment Boundaries</u></p> <ul style="list-style-type: none"> Tasks should not include distinguishing between mass and weight. Students' descriptions should be limited to a written response. Pictorial descriptions would be possible as part of a technology enhanced item 		<p align="center"><u>Sample Stems</u></p> <p>A group of students are on a trip and notice white crystals on some rocks along the beach. The white crystals look just like salt. The students collect some of the crystals, along</p>

Grades 3-5 SCIENCE

Possible Evidence

- Students measure and graph the given quantities using standard units, including the following:
 - The weight of substances before they are heated, cooled, or mixed.
 - The weight of substances, including any new substances produced by a reaction, after they are heated, cooled, or mixed.
- Students measure and/or calculate the difference between the total weight of the substances (using standard units) before and after they are heated, cooled, and/or mixed.
- Students describe the changes in properties they observe during and/or after heating, cooling, or mixing substances.
- Students use their measurements and calculations to describe that the total weights of the substances did not change, regardless of the reaction or changes in properties that were observed.
- Students use measurements and descriptions of weight, as well as the assumption of consistent patterns in natural systems, to describe evidence to address scientific questions about the conservation of the amount of matter, including the idea that the total weight of matter is conserved after heating, cooling, or mixing substances.

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

with some pebbles and sand from the beach. They decide to test whether the properties of the substances are similar to salt. The students know that salt dissolves, so they investigate by mixing the different substances into 50 milliliters of water. The students record the results of the five different tests in Table 1.

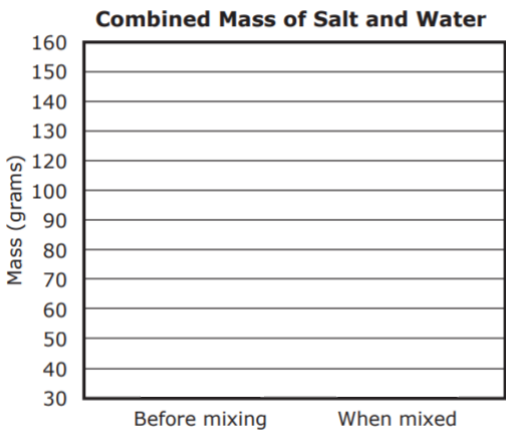
Table 1. Substances Mixed with 50 Milliliters of Water

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1	salt from kitchen	10 grams	not visible
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4	sand from beach	10 grams	visible
5	pebbles from beach	10 grams	visible

For Test 1, the students begin by measuring the mass of the salt and the mass of the water separately on a balance. They find that the mass of 50 milliliters of water is 50 grams. Then they mix the substances together and measure the combined mass. They make a graph to compare the masses.

1. Draw and shade each bar to the correct height.

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After the students complete Test 1, they leave the container near the window. After a week, they look at the container. There is no water left, but salt crystals have formed at the bottom of the container.

1. How many grams of salt are left in the container?

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Physical Sciences		5.PS1.B.1
Core Idea Component MLS	Matter and Its Interactions Types of Interactions of Matter Plan and conduct investigations to separate the components of a mixture/solution by their physical properties (i.e., sorting, filtration, magnets, and screening).	
<u>Expectation Unwrapped</u> <u>SCIENCE AND ENGINEERING PRACTICES</u> Planning and Carrying Out Investigations <ul style="list-style-type: none"> Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using a fair test in which variables are controlled and the number of trials are considered. Describe ways to separate the components of a mixture/solution by their properties (i.e., sorting, filtration, magnets, screening). Constructing Explanations and Designing Solutions <ul style="list-style-type: none"> Apply scientific ideas to solve design problems. <u>DISCIPLINARY CORE IDEAS</u> Mixtures and Solutions <ul style="list-style-type: none"> Matter exists as different substances that have observable different properties. Components of mixtures and solutions can be separated using a variety of methods, depending on the properties of the individual components. <u>CROSSINGCUTTING CONCEPTS</u> Cause and Effect <ul style="list-style-type: none"> Cause and effect relationships are routinely identified and used to explain change. 		<u>DOK Ceiling</u> 3 <u>Item Format</u> Selected Response Constructed Response Technology Enhanced
<u>Content Limits/Assessment Boundaries</u> <ul style="list-style-type: none"> Tasks should avoid specific events or steps in a procedure. 		<u>Sample Stems</u> The Williamson's have a closet where they store all of their craft supplies. One day, one of the shelves collapsed and went crashing to

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Possible Evidence

- From the given investigation plan, students describe the phenomenon (observable event) under investigation, which includes the separation of two or more substances in a mixture or solution.
- From the given investigation plan, students describe the evidence from data that will be collected, including
 - quantitative (e.g., weight) and qualitative (e.g., state of matter, color, texture, odor) properties of the mixture or solution to be separated.
- Students describe how the collected data can serve as evidence for the separation of mixture or solution into individual components.
- From the given investigation plan, students describe how the data will be collected, including the following:
 - How quantitative and qualitative properties of the mixture or solution to be separated will be determined and measured
 - The method of separation, along with the appropriate tools for separation (i.e., sorting, filtration, magnets, and screening).
 - Number of trials for the investigation
 - How variables will be controlled to ensure a fair test
- According to the investigation plan, students collaboratively collect and record data, including data about the mixture or solution after separating.

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

the floor. Unfortunately, all of the containers on the shelf also broke when they hit the floor. As a result, the contents of the containers spilled all over the floor and mixed together. The family wanted to save as much as they could, so they tried to figure out a way to separate the new mixture. The items that fell included the following list:

- sand
- gravel (small rocks)
- small metal stars made of iron
- craft paper
- scissors

1. Describe a method the Williamson's could use to separate the sand from the mixture.
2. Identify and describe a method the Williamson's could use to separate the gravel from the mixture.
3. Identify and describe the Williamson's could use to separate the small metal stars from the mixture.
4. Identify and describe a method the Williamson's could use to separate the scissors from the mixture

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Physical Sciences		5.PS1.B.2
Core Idea	Matter and Its Interactions	
Component	Types of Interactions of Matter	
MLS	Conduct an investigation to determine whether the combining of two or more substances results in new substances.	
<u>Expectation Unwrapped</u>		<u>DOK Ceiling</u> 3
<u>SCIENCE AND ENGINEERING PRACTICES</u> Planning and Carrying Out Investigations <ul style="list-style-type: none"> Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials is considered. <u>DISCIPLINARY CORE IDEAS</u> Chemical Reactions <ul style="list-style-type: none"> When two or more different substances are mixed, a new substance with different properties may be formed. <u>CROSSCUTTING CONCEPTS</u> Cause and Effect <ul style="list-style-type: none"> Cause and effect relationships are routinely identified and used to explain change. 		<u>Item Format</u> Selected Response Constructed Response Technology Enhanced
<u>Content Limits/Assessment Boundaries</u>		<u>Sample Stems</u>
<ul style="list-style-type: none"> Students' descriptions should be limited to a written response. Pictorial descriptions would be possible as part of a technology enhanced item. 		Reactions with Vinegar A student wants to know if they can combine different ingredients with vinegar to create a new substance. She gathers the following items: vinegar, baking soda, sugar, salt, a graduated cylinder, and three beakers. Then, she follows the following procedure:

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Possible Evidence

- From the given investigation plan, students describe the phenomenon (observable event) under investigation, which includes the mixing of two or more substances.
- Students identify the purpose of the investigation, which includes providing evidence for whether new substances are formed by mixing two or more substances, based on the properties of the resulting substance.
- From the given investigation plan, students describe the evidence from data that will be collected, including the following:
 - Quantitative (e.g., weight) and qualitative properties (e.g., state of matter, color, texture, odor) of the substances to be mixed
 - Quantitative and qualitative properties of the resulting substances
- Students describe how the collected data can serve as evidence for whether the mixing of the two or more tested substances results in one or more new substances.
- From the given investigation plan, students describe how the data will be collected, including the following:
 - How quantitative and qualitative properties of the two or more substances to be mixed will be determined and measured
 - How quantitative and qualitative properties of the substances that resulted from the mixture of two or more substances will be determined and measured
 - The number of trials for the investigation
 - How variables will be controlled to ensure a fair test (e.g., the temperature at which the substances are mixed, the number of substances mixed together in each trial)
- According to the investigation plan, students collaboratively collect and record data, including data about the substances before and after mixing.

1. Measure out 10 g of the baking soda, 8 g of sugar, and 8 g of the salt and place each in a separate beaker.
2. Measure out 10 ml of the vinegar in the graduated cylinder.
3. Mix the baking soda and vinegar together in a beaker and record your observations
4. Measure out 12 ml of the vinegar in the graduated cylinder.
5. Mix it with the sugar and record your observations.
6. Measure out 10 ml of the vinegar in the graduated cylinder and heat it to 35°C.
7. Pour the vinegar over the salt and stir it for 2 minutes. Then, record your observations.
8. Each ingredient was mixed with vinegar at the same time.

Stimulus Materials


Graphic organizers, diagrams, graphs, data tables, drawings

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Vinegar Mixing with Different Substances			
Ingredient	amount of ingredient (g)	Amount of Vinegar (ml)	Observation
baking soda	10	10	bubbles formed in the beaker; some of the baking soda disappeared
sugar	8	12	the sugar sank to the bottom of the vinegar and stayed there
salt	8	10	the salt dissolved in the vinegar

1. Select two ways the student's investigation could be changed to make it a fair test.
2. a. Do you think that the student's observations are reliable and accurate?
b. Explain your reasoning to Part A.

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Physical Sciences		5.PS2.B.1
Core Idea	Motion and Stability: Forces and Interactions	
Component	Types of Interaction	
MLS	Support an argument that the gravitational force exerted by Earth on objects is directed toward the planet's center.	
<u>Expectation Unwrapped</u>		<u>DOK Ceiling</u> 3
<u>SCIENCE AND ENGINEERING PRACTICES</u> Engaging in Argument from Evidence <ul style="list-style-type: none"> Support an argument with evidence, data, or a model. <u>DISCIPLINARY CORE IDEAS</u> Types of Interactions <ul style="list-style-type: none"> The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. <u>CROSSCUTTING CONCEPTS</u> Cause and Effect <ul style="list-style-type: none"> Cause and effect relationships are routinely identified and used to explain change. 		<u>Item Format</u> Selected Response Constructed Response Technology Enhanced
<u>Content Limits/Assessment Boundaries</u> <ul style="list-style-type: none"> Tasks should not include mathematical representations (e.g., formulas, numbers, units) of gravitational force. Tasks should include a minimum of two dimensions. Students' descriptions should be limited to a written response. Pictorial descriptions would be possible as part of a technology enhanced item. 		<u>Sample Stems</u> Figure 1. The Setting Sun 
<u>Possible Evidence</u> <ul style="list-style-type: none"> Students identify a given claim about a phenomenon to be supported. The claim includes the idea that the gravitational force exerted by Earth on objects is directed toward the center of the Earth. Students identify and describe the given evidence, data, and/or models that support the claim, including the following: 		

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- Multiple lines of evidence that indicate that Earth's shape is spherical (e.g., observation of ships sailing beyond the horizon, the shape of Earth's shadow on the moon during an eclipse, the changing height of the North Star above the horizon as people travel north and south)
- That objects dropped appear to fall straight down
- That people live all around the spherical Earth, and they all observe that objects appear to fall straight down
- Students evaluate the evidence to determine whether it is sufficient and relevant to supporting the claim.
- Students describe whether any additional evidence is needed to support the claim.
- Students use reasoning to connect the relevant and appropriate evidence to support the claim with argumentation. Students describe a chain of reasoning that includes the following:
 - If Earth is spherical, and all observers see objects near them falling directly "down" to the Earth's surface, then all observers would agree that objects fall toward Earth's center.
 - Since an object that is initially stationary when held moves downward when it is released, there must be a force (gravity) acting on the object that pulls the object toward the center of the Earth.

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

Figure 2. Path of Thrown Pebble



Students on a camping trip in Maryland saw the sun setting as they played on a hilltop (Figure 1). When stars appeared overhead one student noticed that the stars were dim and tiny compared to the Sun. The student picked up a pebble and held it up at arm's length toward the sky. The pebble covered up one star, then another, and another. One of the students said that in South American night skies, there are many stars that are not visible in North America. Later, the student with the pebble threw pebbles toward the stars. Each pebble thrown toward the sky followed a similar path as it returned to Earth's surface (Figure 2).

1. What causes the pebble to follow the path shown in Figure 2 and fall back down to the Earth, after it is thrown in the air?
 - a. The force of Earth's gravity
 - b. the force of the Sun's gravity

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	<ul style="list-style-type: none">c. the force of the Moon's gravityd. the force of the Earth's, the Sun's, and the Moon's gravity combined
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Grades 3-5 SCIENCE

Physical Sciences		5.PS3.D.1
Core Idea	Energy	
Component	Energy in Chemical Process and Everyday	
MLS	Use models to describe that energy stored in food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.	
<u>Expectation Unwrapped</u>		<u>DOK Ceiling</u> 3
<u>SCIENCE AND ENGINEERING PRACTICES</u> Developing and Using Models <ul style="list-style-type: none"> Use models to describe phenomena. <u>DISCIPLINARY CORE IDEAS</u> Energy in Chemical Processes and Everyday Life <ul style="list-style-type: none"> The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). Organization for Matter and Energy <ul style="list-style-type: none"> Food provides animals with the materials they need for body repair and growth, the energy they need to maintain body warmth, and for motion. <u>CROSSCUTTING CONCEPTS</u> Energy and Matter <ul style="list-style-type: none"> Energy can be transferred in various ways and between objects. 		<u>Item Format</u> Selected Response Constructed Response Technology Enhanced
<u>Content Limits/Assessment Boundaries</u>		<u>Sample Stems</u>
<ul style="list-style-type: none"> A minimum of two dimensions should be assessed. Students' descriptions should be limited to a written response. Pictorial descriptions would be possible as part of a technology enhanced item. 		A student is walking and sees acorns all over the sidewalk. The student collects one for further investigation. The student then does some research and learns the following facts: <ul style="list-style-type: none"> Acorns are the seeds of oak trees; Deer, wild turkeys, squirrels, blue jays, and acorn weevils eat acorns; The acorn weevil, an insect, lays eggs inside of acorns;

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Possible Evidence

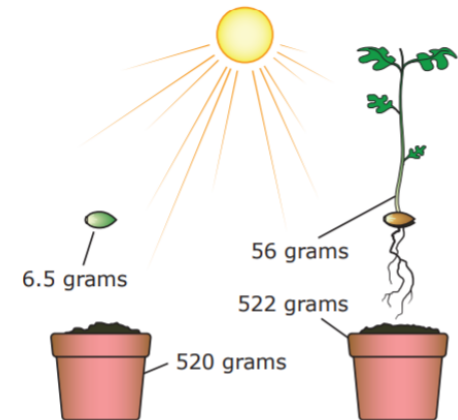
- Students use models to describe a phenomenon (observable event) that includes the idea that energy in animals' food was once energy from the sun. Students identify and describe the components of the model that are relevant for describing the phenomenon, including
 - o energy.
 - o the sun.
 - o animals, including their bodily functions (e.g., body repair, growth, motion, body warmth maintenance).
 - o plants.
- Students identify and describe the relevant relationships between components, including the following:
 - o The relationship between plants and the energy they get from sunlight to produce food
 - o The relationship between food and the energy and materials that animals require for bodily functions (e.g., body repair, growth, motion, body warmth maintenance)
 - o The relationship between animals and the food they eat, which is either other animals or plants (or both), to obtain energy for bodily functions and materials for growth and repair
- Students use the models to describe causal accounts of the relationships between energy from the sun and animals' needs for energy, including that
 - o since all food can eventually be traced back to plants, all of the energy that animals use for body repair, growth, motion, and body warmth maintenance is energy that once came from the sun.
 - o energy from the sun is transferred to animals through a chain of events that begins with plants producing food then being eaten by animals.

- Acorns that are dropped from oak trees are called "mast."

The student learns that factors in both the living and non-living environment can affect the acorn mast year to year. The mast ratings for recent years are provided in Figure 2. Mast ratings range from 0 to 5. A mast rating of 0 indicates no acorns are present. A mast rating of 5 indicates a very large number of acorns are present.

The student decides to plant an acorn in a pot of soil after determining their masses. The student places the pot on a windowsill in their classroom in direct sunlight. They add 25 milliliters of water to the soil every day for two months. After two months of growth, the oak seedling is carefully removed from the

Figure 1. Acorn Investigation



The student plants an acorn in a pot of soil after determining their masses. The student places the pot on a windowsill in their classroom in direct sunlight. They add 25 milliliters of water to the soil every day for two months. After two months of growth, the oak seedling is carefully removed from the

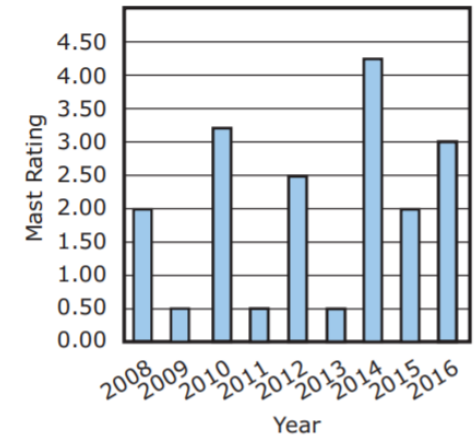
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Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

pot and all soil on the plant roots is scraped off the roots and returned to the pot. The mass of the seedling is determined, and after the soil is allowed to dry, the mass of the pot and soil is determined.

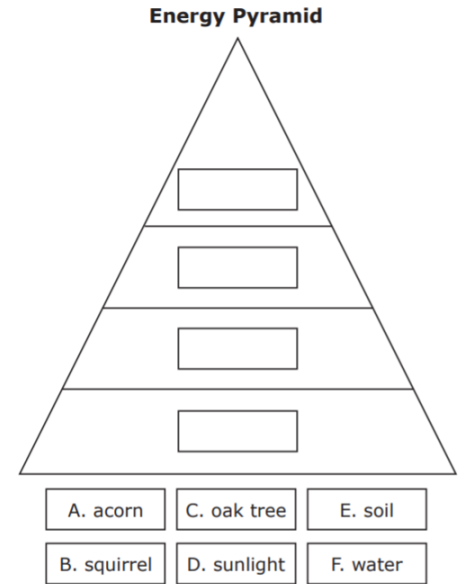
Figure 2. Acorn Mast Ratings by Year



Source: North Carolina Wildlife Resources Commission

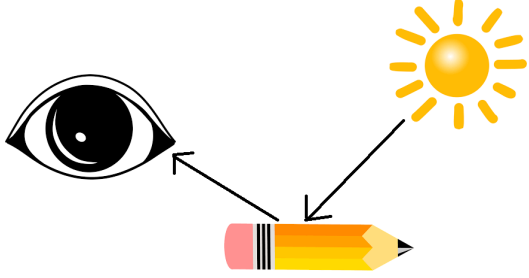
1. Make a model to show how squirrels get the energy they need to live. The narrowing of the pyramid as it gets taller represents the loss of some energy each time energy is transferred. The bottom of the pyramid is the source of energy in the system. Write the correct answer in each box to complete the model. Not all answers will be used.

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2. Describe the flow of energy from the non-living environment to the acorn weevil.
3. Describe how the acorn weevil obtains and uses matter from the non-living environment for its growth.

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Physical Sciences		5.PS4.A.1
Core Idea Component MLS	Waves and Their Applications in technologies for Information Transfer Wave Properties Develop a model to describe that objects can be seen only when light is reflected off them or when they produce their own light.	
<u>Expectation Unwrapped</u> <u>SCIENCE AND ENGINEERING PRACTICES</u> Developing and Using Models <ul style="list-style-type: none"> Develop and/or use models to describe and/or predict phenomena. <u>DISCIPLINARY CORE IDEAS</u> Electromagnetic Radiation <ul style="list-style-type: none"> Objects can be seen when light reflected from their surfaces enters our eyes. <u>CROSSCUTTING CONCEPTS</u> Cause and Effect <ul style="list-style-type: none"> Events that occur together with regularity might or might not be a cause and effect relationship. Systems and System Model <ul style="list-style-type: none"> A system can be described in terms of its components and their interactions. 		<u>DOK Ceiling</u> 3 <u>Item Format</u> Selected Response Constructed Response Technology Enhanced
<u>Content Limits/Assessment Boundaries</u> <ul style="list-style-type: none"> Tasks should not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works. Tasks should not include evaluation of the limitations of models. 		<u>Sample Stems</u> 

Grades 3-5 SCIENCE

Possible Evidence

- Students develop a model to describe a phenomenon (observable event) that includes the idea that objects can be seen only when light is reflected off them or when they produce their own light. In the model, students identify the relevant components for the phenomenon, including the following:
 - A light source
 - An object that can be seen
- In the model, students identify and describe the relevant relationship between components, including the relationship between the light source and an object to be seen.
- Students use the model to describe observable phenomena (e.g., light reflection, light production, or where a light source may not be present.)

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

The child is able to see the pencil because the light source, which is the (lamp, **sun**, eye), is (**reflecting**, absorbing) light off of the pencil.

Grades 3-5 SCIENCE

Life Sciences		5.LS1.A.1
Core Idea Component MLS	From Molecules to Organisms: Structure and Processes Structure and Function Compare and contrast the major organs/organ systems (e.g., support, reproductive, digestive, transport/circulatory, excretory, response) that perform similar functions for animals belonging to different vertebrate classes.	
<u>Expectation Unwrapped</u> [Clarification Statement: Identifying similarities and differences between major parts of organisms.] <u>SCIENCE AND ENGINEERING PRACTICES</u> Constructing Explanations and Designing Solutions <ul style="list-style-type: none"> Identify the evidence that supports particular points and in explanation. Engaging in Argument from Evidence <ul style="list-style-type: none"> Construct and/or support an argument with evidence, data, and/or a model. <u>DISCIPLINARY CORE IDEAS</u> Structure and Function <ul style="list-style-type: none"> Organisms have both internal and external macroscopic structures that allow for growth, survival, behavior, and reproduction with organs that are specialized for particular body functions. <u>CROSSCUTTING CONCEPTS</u> Systems and System Model <ul style="list-style-type: none"> Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. Students can also describe a system in terms of its components and their interactions. Energy and Matter <ul style="list-style-type: none"> Energy can be transferred in various ways and between objects. 		<u>DOK Ceiling</u> 3 <u>Item Format</u> Selected Response Constructed Response Technology Enhanced
<u>Content Limits/Assessment Boundaries</u> <ul style="list-style-type: none"> Tasks should be limited to macroscopic structures within animal systems. Tasks should be limited to the following systems: nervous, circulatory, muscular, skeletal, and digestive. 		<u>Sample Stems</u> Below are models of the skeletal systems of a penguin and a bear.

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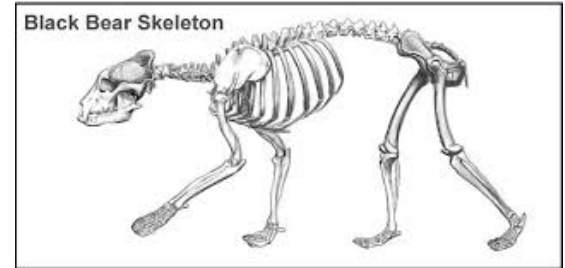
Possible Evidence

- Students compare and contrast the major organs/organ systems that perform similar functions for animals belonging to different vertebrate classes.
- Organs/Organ Systems
 - support—skeletal and muscular
 - reproductive
 - digestive
 - circulatory/transport
 - excretory
 - response—nervous
 - respiratory
- Vertebrate Classes
 - birds
 - fish
 - amphibians
 - reptiles
 - mammals

Penguin Skeleton



Black Bear Skeleton



Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

- Describe one similarity between the skeletal system of the penguin and the bear.
- Describe one difference between the skeletal system of the penguin and the bear.

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Life Sciences		5.LS1.C.1
Core Idea Component MLS	From Molecules to Organisms: Structure and Processes Organization for Matter and Energy Flow in Organisms Support an argument that plants get the materials (i.e., carbon dioxide, water, and sunlight) they need for growth chiefly from air and water.	
<u>Expectation Unwrapped</u> [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.] <u>SCIENCE AND ENGINEERING PRACTICES</u> Engaging in Argument from Evidence <ul style="list-style-type: none"> Support an argument with evidence, data, or a model. <u>DISCIPLINARY CORE IDEAS</u> Organization for Matter and Energy Flow in Organisms <ul style="list-style-type: none"> Plants acquire their material for growth chiefly from air and water. <u>CROSSCUTTING CONCEPTS</u> Energy and Matter <ul style="list-style-type: none"> Matter is transported into, out of, and within systems. 		<u>DOK Ceiling</u> 3 <u>Item Format</u> Selected Response Constructed Response Technology Enhanced
<u>Content Limits/Assessment Boundaries</u> <ul style="list-style-type: none"> Tasks should not include knowing the formula for photosynthesis. Students should not be required to know reactants or products. Students' descriptions should be limited to a written response. Pictorial descriptions would be possible as part of a technology enhanced item. 		<u>Sample Stems</u> A student is walking and sees acorns all over the sidewalk. The student collects one for further investigation. The student then does some research and learns the following facts: <ul style="list-style-type: none"> Acorns are the seeds of oak trees. Deer, wild turkeys, squirrels, blue jays, and acorn weevils eat acorns.

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Possible Evidence

- Students identify a given claim to be supported about a given phenomenon (observable event). The claim includes the idea that plants acquire the materials they need for growth chiefly from air and water.
- Students describe the given evidence, data, and/or models that support the claim, including evidence of the following:
 - o Plant growth over time
 - o Changes in the weight of soil and water within a closed system with a plant, indicating that soil does not provide most of the material for plant growth (e.g., changes in weight of soil and a plant in a pot over time, hydroponic growth of plants)
 - o Plants' inability to grow without water
 - o Plants' inability to grow without air
- Students determine whether the evidence supports the claim, including the following:
 - o Whether a particular material (e.g., air, soil) is required for the growth of plants
 - o Whether a particular material (e.g., air, soil) may provide sufficient matter to account for an observed increase in weight of a plant during growth
- Students use reasoning to connect the evidence to support the claim with argumentation. Students describe a chain of reasoning that includes the following:
 - o During plant growth in soil, the weight of the soil changes very little over time, whereas the weight of the plant changes a lot. Additionally, some plants can be grown without soil at all.
 - o Because some plants don't need soil to grow and others show increases in plant matter (as measured by weight) but not accompanying decreases in soil matter, the material from soil must not enter the plant in sufficient quantities to be the chief contributor to plant growth.
 - o Therefore, plants do not acquire most of the material for growth from soil.
 - o A plant cannot grow without water or air. Because both air and water are matter and are transported into the plant system, they can provide the materials plants need for growth.
 - o Since soil cannot account for the change in weight as a plant grows and since plants take in water and air, both of which could contribute to the increase in weight during plant growth, plant growth must come chiefly from water and air.

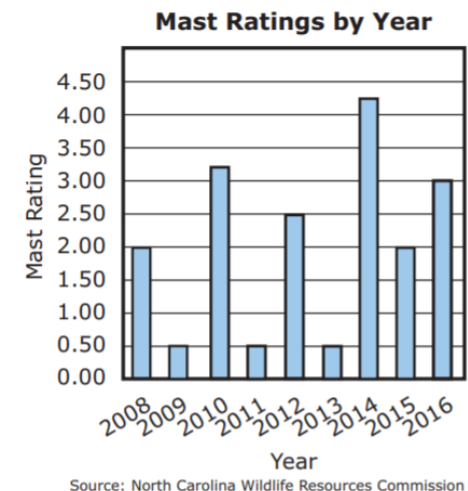
Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

- The acorn weevil, an insect, lays eggs inside of acorns.
- Acorns that are dropped from oak trees are called "mast."
- The Sun helps the acorn make food once it becomes a seedling.

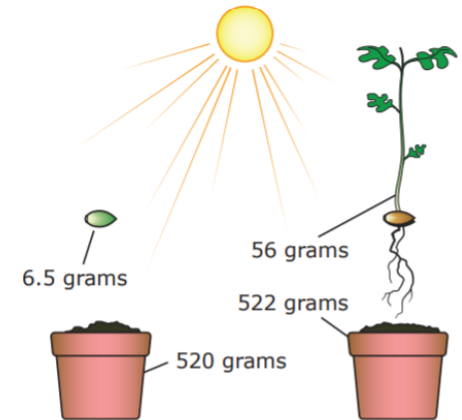
The student learns that factors in both the living and non-living environment can affect the acorn mast or the number of acorns produced from year to year. The mast ratings for recent years are provided in Figure 1. Mast ratings range from 0 to 5. A mast rating of 0 indicates no acorns are present. A mast rating of 5 indicates a very large number of acorns are present.

Figure 1: Acorn Mast Ratings by Year



The student decides to plant an acorn to perform the investigation described in Figure 2.

Figure 2: Acorn Growth



The student plants an acorn in a pot of soil after determining their masses. The student places the pot on a windowsill in their classroom in direct sunlight. They add 25 milliliters of water to the soil every day for two months. After two months of growth, the oak seedling is carefully removed from the pot. All soil is scraped off the roots and returned to the pot. The mass of the seedling was determined to have more mass than the acorn that was planted. After the soil is allowed to dry, the mass of the pot and soil was determined to be the same before and after the acorn was planted.

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1. After examining Figure 1, the student argues that in the years 2010 and 2014, the tree had more of the materials it needed to make food. What evidence could the student use to support this idea?
2. After completing the acorn investigation shown in Figure 2, the student makes the claim that plants gain mass by taking matter from air and water. Write the answers that support the claim in the box. Not all answers will be used.

A. plant gained mass

B. plant received direct sunlight

C. soil did not lose mass

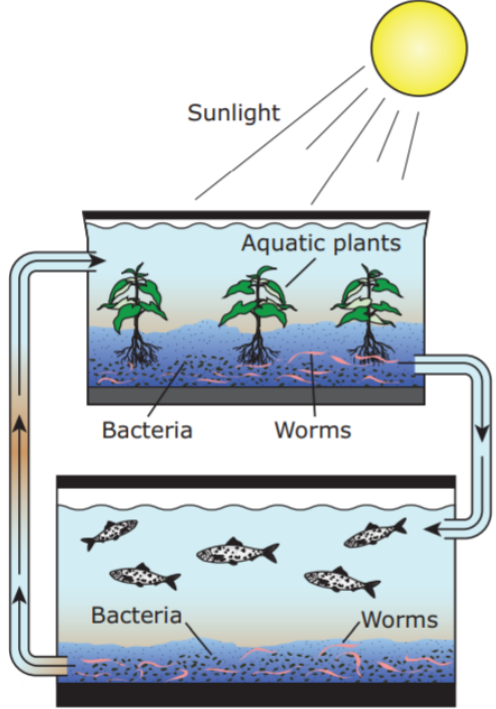
D. plant was provided water daily

Supports the claim

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Life Sciences		5.LS2.B.1
Core Idea	Ecosystems: Interactions, Energy, and Dynamics	
Component	Cycles of matter and Energy Transfer in Ecosystems	
MLS	Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	
<u>Expectation Unwrapped</u>		<u>DOK Ceiling</u> 3
<p>[Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and Earth.]</p> <p><u>SCIENCE AND ENGINEERING PRACTICES</u></p> <p>Developing and Using Models</p> <ul style="list-style-type: none"> Develop a model to describe phenomena. <p><u>DISCIPLINARY CORE IDEAS</u></p> <p>Interdependent Relationships in Ecosystems</p> <ul style="list-style-type: none"> The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as decomposers. Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. <p>Cycles of Matter and Energy Transfer in Ecosystems</p> <ul style="list-style-type: none"> Matter cycles between the air and soil and between plants, animals, and microbes as these organisms live and die. Organisms obtain gases and water from the environment and release waste matter (gas, liquid, or solid) back into the environment. <p><u>CROSSCUTTING CONCEPTS</u></p> <p>Systems and System Models</p> <ul style="list-style-type: none"> A system can be described in terms of its components and their interactions. 		<p><u>Item Format</u></p> <p>Selected Response Constructed Response Technology Enhanced</p>

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<p style="text-align: center;"><u>Content Limits/Assessment Boundaries</u></p> <ul style="list-style-type: none"> Students' descriptions should be limited to a written response. Pictorial descriptions would be possible as part of a technology enhanced item. 	<p style="text-align: center;"><u>Sample Stems</u></p> <p>A student reads about growing plants in water with no soil. The student's teacher tells the student that fish can be raised using the same water in which aquatic plants grow. The student researches to discover if the fish and the plants somehow help each other to grow. The student makes a sketch of a model of how a system like this might work (Figure 1).</p> <p style="text-align: center;">Figure 1. Growing Plants and Raising Fish with No Soil</p>  <p>1. In the system shown in Figure 1, fish, worms and bacteria, and plants help keep the system healthy. What would</p>
<p style="text-align: center;"><u>Possible Evidence</u></p> <ul style="list-style-type: none"> Students develop a model to describe a phenomenon (observable event) that includes the movement of matter within an ecosystem. In the model, students identify the relevant components, including <ul style="list-style-type: none"> matter. plants. animals. decomposers, such as fungi and bacteria. environment. Students describe the relationships among components that are relevant for describing the phenomenon, including <ul style="list-style-type: none"> the relationships in the system between organisms that consume other organisms, such as <ul style="list-style-type: none"> animals that consume other animals. animals that consume plants. 	
<p style="text-align: center;"><u>Stimulus Materials</u></p> <p>Graphic organizers, diagrams, graphs, data tables, drawings</p>	

happen if parts of the system were missing? Match each part to the effect it would have on the system if that part were missing.
 Write the correct answer in each box.

A. Water would contain less oxygen.

B. Water would contain fewer nutrients.

C. Water would contain more waste and dead matter.

Plants

Fish

Bacteria and Worms

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Earth and Space Sciences		5.ESS1.A.1
Core Idea	Earth’s Place in the Universe	
Component	The Universe and its Stars	
MLS	Support an argument that relative distances from Earth affect the apparent brightness of the sun compared to other stars.	
<u>Expectation Unwrapped</u>		<u>DOK Ceiling</u> 3
<u>SCIENCE AND ENGINEERING PRACTICES</u> Engaging in Argument from Evidence <ul style="list-style-type: none">Support an argument with evidence, data, or a model. <u>DISCIPLINARY CORE IDEAS</u> The Universe and Its Stars <ul style="list-style-type: none">The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. <u>CROSSCUTTING CONCEPTS</u> Scale, Proportion, and Quantity <ul style="list-style-type: none">Natural objects exist, from the very small to the immensely large.		<u>Item Format</u> Selected Response Constructed Response Technology Enhanced
<u>Content Limits/Assessment Boundaries</u> <ul style="list-style-type: none">Tasks are limited to relative distances, not sizes, of stars.Tasks should not include other factors that affect apparent brightness (e.g., stellar masses, age, life-cycle stage).Students’ descriptions should be limited to a written response. Pictorial descriptions would be possible as part of a technology enhanced item.Data sets should be given in order to provide students with evidence needed to support their arguments.		<u>Sample Stems</u>
<u>Possible Evidence</u> <ul style="list-style-type: none">Students identify a given claim that is about a phenomenon to be supported. The claim includes the idea that the apparent brightness of the sun and stars is due to their relative distances from Earth.		

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- Students describe the evidence, data, and/or models that support the claim, such as
 - the sun and other stars are natural bodies in the sky that give off their own light.
 - the apparent brightness of a variety of stars, including the sun.
 - a luminous object close to a person appears much brighter and larger than a similar object that is very far away from a person (e.g., nearby streetlights appear bigger and brighter than distant streetlights).
 - the relative distance of the sun and stars from Earth (e.g., although the sun and other stars are all far from Earth, the stars are very much farther away; the sun is much closer to Earth than other stars).
- Students evaluate the evidence to determine whether it is relevant to supporting the claim and sufficient to describe the relationship between apparent size and apparent brightness of the sun and other stars and their relative distances from Earth.
- Students determine whether additional evidence is needed to support the claim.
- Students use reasoning to connect the relevant and appropriate evidence to the claim with argumentation. Students describe a chain of reasoning that includes points such as the following:
 - Because stars are defined as natural bodies that give off their own light, the sun is a star.
 - The sun is many times larger than Earth but appears small because it is very far away.
 - Even though the sun is very far from Earth, it is much closer to Earth than other stars.
 - Because the sun is closer to Earth than any other star, it appears much larger and brighter than any other star in the sky.
 - Because objects appear smaller and dimmer the farther they are from the viewer, other stars, although immensely large compared to the Earth, seem much smaller and dimmer because they are so far away.
 - Although stars are immensely large compared to Earth, they appear small and dim because they are so far away.
 - Similar stars vary in apparent brightness, indicating that they vary in distance from Earth.

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

Figure 1. The Setting Sun



Figure 2. Path of Thrown Pebble



Students on a camping trip in Maryland saw the sun setting as they played on a hilltop (Figure 1). When stars appeared overhead one student noticed that the stars were dim and tiny compared to the Sun. The student picked up a pebble and held it up at arm's length toward the sky. The pebble covered up one star, then another, and another. One of the students said that in South American night skies, there are many stars that are not visible in North America. Later, the student

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with the pebble threw pebbles toward the stars. Each pebble thrown toward the sky followed a similar path as it returned to Earth's surface (Figure 2).

1. Which of the following characteristic is true about the stars in Figure 2?
 - a. They are the same size as the pebble.
 - b. They shine because they reflect the light of the Sun.
 - c. They are different distances from Earth than the Sun.
 - d. They disappear during the day because they move out of the sky.
2. The Sun appears huge and bright from Earth, but a student can cover other stars with a single pebble from a hilltop on Earth. Explain this difference by completing the sentence.

Write the correct answer in each box.

A. less than

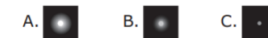
B. greater than

The distance from the Earth to the Sun is
the distance from the Earth to the Moon. The distance from
the Earth to the Sun is the distance from
the Earth to the other stars.

3. After sunset on the hilltop, the students notice three stars of different brightness. These stars are all the same type of star. Predict the relative distances from Earth for these three stars. Write the correct answer in each box.

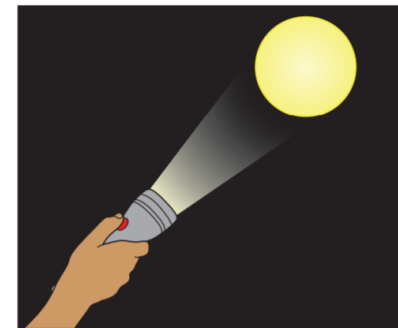


not to scale



4. A student claims the following:
“The Sun appears brighter than other stars because it is closer to Earth.”

Figure 3. Student Using a Flashlight



- a. Explain how students could support the claim by modeling the distance from Earth to the Sun and the other stars with two flashlights.

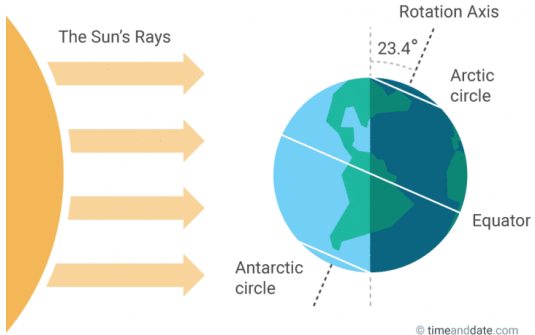
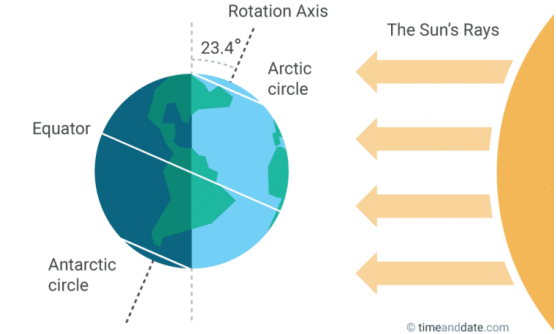
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	<p>b. A student sees two lights of equal brightness on the distant horizon. Can the student make an argument about the distance between the lights and the student using only this evidence? Explain your answer.</p>
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Earth and Space Sciences		5.ESS1.B.1
Core Idea	Earth's Place in the Universe	
Component	Earth and the Solar System	
MLS	Make observations during different seasons to relate the amount of daylight to the time of year.	
<u>Expectation Unwrapped</u>		<u>DOK Ceiling</u> 3
<p>[Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.]</p> <p><u>SCIENCE AND ENGINEERING PRACTICES</u></p> <p>Asking Questions and Solving Problems</p> <ul style="list-style-type: none"> Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. <p>Analyzing and Interpreting Data</p> <ul style="list-style-type: none"> Represent data in tables and/or various graphical displays, bar graphs, pictographs, and/or pie charts to reveal patterns that indicate relationships. <p>Using Mathematics and Computational Thinking</p> <ul style="list-style-type: none"> Organize simple data sets to reveal patterns that suggest relationships. <p><u>DISCIPLINARY CORE IDEAS</u></p> <p>Seasons</p> <ul style="list-style-type: none"> Patterns of seasons can be observed, described, and predicted. <p><u>CROSSCUTTING CONCEPTS</u></p> <p>Patterns</p> <ul style="list-style-type: none"> Patterns of change can be used to make predictions. <p>Cause and Effect</p> <ul style="list-style-type: none"> Events that occur together with regularity might or might not be a cause and effect relationship. <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> Natural objects and/or observable phenomena exist, from the very small to the immensely large or from very short to very long time periods. <p>Stability and Change</p> <ul style="list-style-type: none"> Change is measured in terms of differences over time and may occur at different rates. 		<u>Item Format</u> Selected Response Constructed Response Technology Enhanced

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<p style="text-align: center;"><u>Content Limits/Assessment Boundaries</u></p> <ul style="list-style-type: none"> • Tasks can include any geographic location as long as sufficient background knowledge is provided. • Students' descriptions should be limited to a written response. Pictorial descriptions would be possible as part of a technology enhanced item. 	<p style="text-align: center;"><u>Sample Stems</u></p> <p>Model A</p>  <p>Model B</p>  <p>Jill created a model of sun rays reaching to the Earth. Jill said illustration A shows summer in the Southern Hemisphere, and illustration B shows summer in the Northern Hemisphere.</p> <ol style="list-style-type: none"> 1. Give one piece of evidence from Model A that shows it is summertime in the Southern Hemisphere. 2. Jill claims that when it is winter in either hemisphere that there is less daylight during that time. Give one
<p style="text-align: center;"><u>Possible Evidence</u></p> <ul style="list-style-type: none"> • From the given investigation plan, students identify the phenomenon under investigation, which includes the following idea: there is a relationship between the time of year and the amount of daylight. • From the given investigation plan, students identify the purpose of the investigation, which includes providing evidence for an explanation of the phenomenon. • From the given investigation plan, students describe the data to be collected that will serve as the basis for evidence. • From the given investigation plan, students describe the evidence needed, based on observations made during the investigation, including <ul style="list-style-type: none"> o the amount of daylight. o the time of year. • Students describe how the data to be collected will serve as evidence of the relationship between the amount of daylight and the time of year. • From the given investigation plan, students describe how the data will be collected, including <ul style="list-style-type: none"> o the amount of daylight. o the time of year. • Students make and record observations according to the given investigation plan to provide evidence for the relationship between the amount of daylight and the time of year. 	
<p style="text-align: center;"><u>Stimulus Materials</u></p> <p>Graphic organizers, diagrams, graphs, data tables, drawings</p>	

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piece of evidence from the models that would support her claim.

In the Northern Hemisphere the winter solstice is the day that the Earth gets the least amount of sunlight. This occurs in the month of December.

Use the data below to answer Part A and Part B.

Date	Sunrise	Sunset	Time of Sunlight Hours/Min/Seconds
December 14, 2020	7:19 AM	4:50 PM	9:31:30
December 15, 2020	7:19 AM	4:51 PM	9:31:07
December 16, 2020	7:20 AM	4:51 PM	9:30:49
December 17, 2020	7:21 AM	4:51 PM	9:30:33
December 18, 2020	7:21 AM	4:52 PM	9:30:22
December 19, 2020	7:22 AM	4:52 PM	9:30:14
December 20, 2020	7:22 AM	4:53 PM	9:30:09
December 21, 2020	7:23 AM	4:53 PM	9:30:00
December 22, 2020	7:23 AM	4:54 PM	9:30:12
December 23, 2020	7:24 AM	4:54 PM	9:30:19
December 24, 2020	7:34 AM	4:55 PM	9:30:29
December 25, 2020	7:25 AM	4:55 PM	9:30:43
December 26, 2020	7:26 AM	4:56 PM	9:31:01

1. Part A: What date did the actual solstice occur?

Part B: What patterns do you notice in the data?

Grades 3-5 SCIENCE

Earth and Space Sciences		5.ESS1.B.2
Core Idea	Earth's Place in the Universe	
Component	Earth and the Solar System	
MLS	Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.	
<p align="center"><u>Expectation Unwrapped</u></p> <p>[Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.]</p> <p><u>SCIENCE AND ENGINEERING PRACTICES</u></p> <p>Analyzing and Interpreting Data</p> <ul style="list-style-type: none"> Represent data in graphical displays (e.g. bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. <p><u>DISCIPLINARY CORE IDEAS</u></p> <p>Earth and the Solar System</p> <ul style="list-style-type: none"> The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South Poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. <p><u>CROSSCUTTING CONCEPTS</u></p> <p>Patterns</p> <ul style="list-style-type: none"> Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena. 		<p align="center"><u>DOK Ceiling</u></p> <p align="center">3</p> <p align="center"><u>Item Format</u></p> <p>Selected Response Constructed Response Technology Enhanced</p>
<p align="center"><u>Content Limits/Assessment Boundaries</u></p> <ul style="list-style-type: none"> Tasks should not include the causes of the seasons. Students' descriptions should be limited to a written response. Pictorial descriptions would be possible as part of a technology enhanced item. 		<p align="center"><u>Sample Stems</u></p> <p>Students were excited to camp out and observe the motion of the Sun during the day and the appearance of the stars at night. As part of a school project, they recorded the position of the Sun in the sky and the position</p>

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Possible Evidence

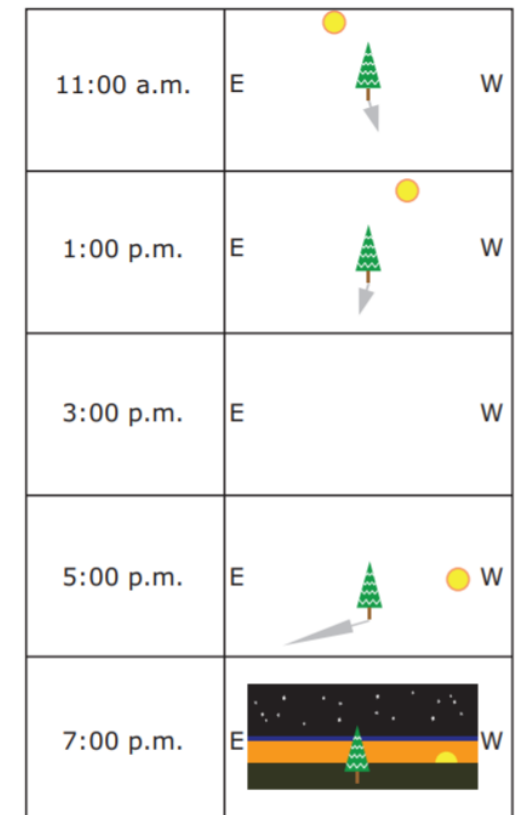
- Using graphical displays (e.g., bar graphs, pictographs) students organize data pertaining to daily and seasonal changes caused by the Earth's rotation and orbit around the sun. Students organize data that includes
 - the length and direction of shadows observed several times during one day.
 - the duration of daylight throughout the year, as determined by sunrise and sunset times.
 - presence or absence of selected stars and/or groups of stars that are visible in the night sky at different times of the year.
- Students use the organized data to find and describe relationships within the datasets, including
 - the apparent motion of the sun from east to west results in patterns of changes in length and direction of shadows throughout a day as Earth rotates on its axis.
 - the length of the day gradually changes throughout the year as Earth orbits the sun, with more daylight hours in the summer and fewer daylight hours in the winter.
 - some stars and/or groups of stars (i.e., constellations) can be seen in the sky all year, while others appear only at certain times of the year.
- Students use the organized data to find and describe the relationships between the datasets, including
 - similarities and differences in the timing of observable changes in shadows, daylight, and the appearance of stars show that events occur at different rates (e.g., Earth rotates on its axis once a day, while its orbit around the sun takes a full year).

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

of the shadow of a tree at different times of the day. The students stood in the same location, directly north of the tree, for each observation. They were having so much fun playing games in the afternoon that they forgot to complete the 3 p.m. drawing. At 7 p.m., while the Sun was going down, the stars came out. The drawings the students produced are shown in Figure 1.

Figure 1. Student Drawing



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	<ol style="list-style-type: none">1. If the students had completed their drawing at 3 p.m., what would it have looked like?2. The students decide to make a graph to show the relationship between the apparent position of the Sun in the sky and the length of the tree shadow. Answer the following to describe how you would complete this task.<ol style="list-style-type: none">a. Describe your graph and how you would you label it.b. What pattern would your graph show?
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Grades 3-5 SCIENCE

Earth and Space Sciences		5.ESS2.A.1
Core Idea	Earth's Systems	
Component	Earth Materials and Systems	
MLS	Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	
<u>Expectation Unwrapped</u>		<u>DOK Ceiling</u> 3
<p>[Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.]</p> <p><u>SCIENCE AND ENGINEERING PRACTICES</u></p> <p>Developing and Using Models</p> <ul style="list-style-type: none"> Develop a model using an example to describe a scientific principle. <p><u>DISCIPLINARY CORE IDEAS</u></p> <p>Earth Materials and Systems</p> <ul style="list-style-type: none"> Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. <p><u>CROSCUTTING CONCEPTS</u></p> <p>Systems and System Models</p> <ul style="list-style-type: none"> A system can be described in terms of its components and their interactions. 		<p><u>Item Format</u></p> <p>Selected Response Constructed Response Technology Enhanced</p>
<u>Content Limits/Assessment Boundaries</u>		<u>Sample Stems</u>
<ul style="list-style-type: none"> Tasks should be limited to the interactions of two systems at time. Students' descriptions should be limited to a written response. Pictorial descriptions would be possible as part of a technology enhanced item. 		<p>A student is hiking and notices a small spring. The student sees that the water is coming up through rocks. The student wonders where the water comes from, and whether it is fresh</p>

Grades 3-5 SCIENCE

Possible Evidence

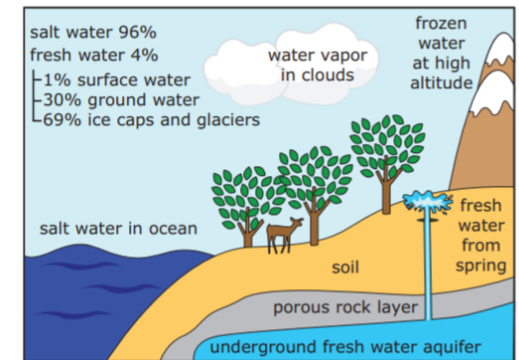
- Students develop a model, using a specific given example of a phenomenon (observable event), to describe ways that the geosphere, biosphere, hydrosphere, and/or atmosphere interact. In their model, students identify the relevant components of their example, including features of two of the following systems that are relevant for the given example:
 - Geosphere (i.e., solid and molten rock, soil, sediment, continents, and mountains)
 - Hydrosphere (i.e., water and ice in the form of rivers, lakes, and glaciers)
 - Atmosphere (i.e., wind and oxygen)
 - Biosphere (i.e., plants and animals [including humans])
- Students identify and describe relationships (interactions) within and between the parts of the Earth systems identified in the model that are relevant to the example (e.g., the atmosphere and the hydrosphere interact by exchanging water through evaporation and precipitation; the hydrosphere and atmosphere interact through air temperature changes, which lead to the formation or melting of ice).
- Students use the model to describe a variety of ways in which the parts of two major Earth systems in the specific given example interact to affect Earth's surface materials and processes in that context.
- Students use the model to describe how parts of an individual Earth system
 - work together to affect the functioning of that Earth system.
 - contribute to the functioning of the other relevant Earth system.

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

or salty. The student finds a diagram of the area (Figure 1) and a graph of the amount of salt in the aquifer water (Figure 2). The student realizes that much of what is pictured in the diagram can be explained by the interaction of the Earth's four spheres: the geosphere, hydrosphere, biosphere, and atmosphere.

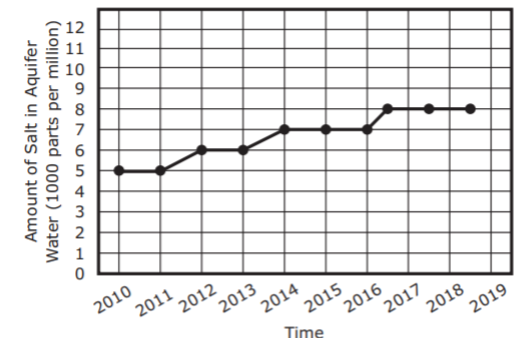
Figure 1. Diagram of the Area



¹spring—A source of water coming up from the ground.

²aquifer—A layer of rock or sand that can absorb and hold water.

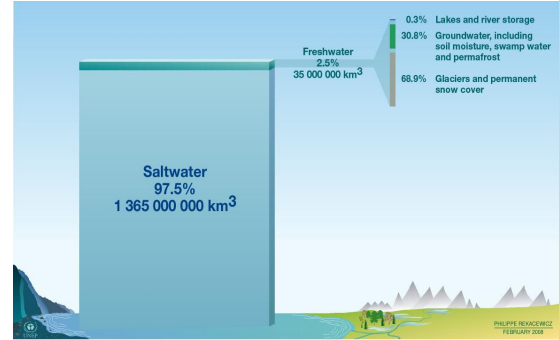
Figure 2. Amount of Salt in Aquifer Water



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	<ol style="list-style-type: none">1. The interaction of what two spheres causes the water to come out of the spring¹?2. The student wants to identify the parts of the map in Figure 1 that shows a relationship between the hydrosphere and atmosphere. What information from Figure 1 shows a relationship between only the hydrosphere and atmosphere?3. Explain how the different spheres work together to provide water for the deer.
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Grades 3-5 SCIENCE

Earth and Space Sciences		5.ESS2.C.1
Core Idea Component MLS	<p>Earth's Systems</p> <p>The Role of Water in Earth's Surface Processes</p> <p>Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.</p>	
<p><u>Expectation Unwrapped</u></p> <p>SCIENCE AND ENGINEERING PRACTICES</p> <p>Using Mathematics and Computational Thinking</p> <ul style="list-style-type: none"> Describe and graph quantities such as area and volume to address scientific questions. <p>DISCIPLINARY CORE IDEAS</p> <p>The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> Nearly all of Earth's available water is in the oceans. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. <p>CROSSCUTTING CONCEPTS</p> <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> Standard units are used to measure and describe physical quantities such as weight and volume. 		<p><u>DOK Ceiling</u></p> <p>3</p> <p><u>Item Format</u></p> <p>Selected Response Constructed Response Technology Enhanced</p>
<p><u>Content Limits/Assessment Boundaries</u></p> <ul style="list-style-type: none"> Tasks should be limited to oceans, lakes, rivers, glaciers, groundwater, and polar ice caps and do not include the atmosphere. Students' descriptions should be limited to a written response. Pictorial descriptions would be possible as part of a technology enhanced item. 		<p><u>Sample Stems</u></p> <p>Model 1</p>  <p>Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris), 1999.</p>

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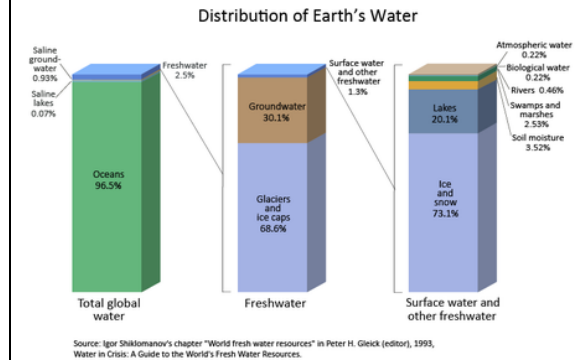
Possible Evidence

- Students graph the given data (using standard units) about the amount of salt water and the amount of fresh water in each of the following reservoirs, as well as in all the reservoirs combined, to address a scientific question:
 - oceans.
 - lakes.
 - rivers.
 - glaciers.
 - ground water.
 - polar ice caps.
- Students use the graphs of the relative amounts of total salt water and total fresh water in each of the reservoirs to describe that
 - o the majority of water on Earth is found in the oceans.
 - o most of the Earth's freshwater is stored in glaciers or underground.
 - o a small fraction of freshwater is found in lakes, rivers, wetlands, and the atmosphere.

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

Model 2



Looking at Models 1 and 2, select the **three** responses that best represent the information given.

- The world has about 95% more saltwater than freshwater.**
- Glaciers and permanent snow contain the most saltwater.
- The majority of the Earth's surface water can be found in groundwater, glaciers, and ice caps.
- Freshwater can be found in soil moisture, swamps, and marshes.**
- The majority of the world's salt water is found in the oceans.**

Grades 3-5 SCIENCE

Earth and Space Sciences		5.ESS3.C.1
Core Idea	Earth and Human Activity	
Component	Human Impacts on Earth's Systems	
MLS	Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	
<u>Expectation Unwrapped</u>		<u>DOK Ceiling</u> 3
<u>SCIENCE AND ENGINEERING PRACTICES</u> Obtaining, Evaluating, and Communicating Information <ul style="list-style-type: none"> Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. <u>DISCIPLINARY CORE IDEAS</u> Human Impacts on Earth Systems <ul style="list-style-type: none"> Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. <u>CROSSCUTTING CONCEPTS</u> Systems and System Models <ul style="list-style-type: none"> A system can be described in terms of its components and their interactions. 		<u>Item Format</u> Selected Response Constructed Response Technology Enhanced
<u>Content Limits/Assessment Boundaries</u>		<u>Sample Stems</u>
<ul style="list-style-type: none"> Students' descriptions should be limited to a written response. Pictorial descriptions would be possible as part of a technology enhanced item. 		In September 1900, a strong hurricane ripped through Galveston, a small island off the coast of Texas. The hurricane had strong wind gusts that tore rain gauges off the weather building, blew signs across roads, and flooded the town. Most of the buildings in the town were destroyed. The waves from the storm rose as high as 5 meters..

Grades 3-5 SCIENCE

Possible Evidence

- Students obtain information from books and other reliable media about
 - how a given human activity (e.g., in agriculture, industry, everyday life) affects the Earth's resources and environments.
 - how a given community uses scientific ideas to protect a given natural resource and the environment in which the resource is found.
- Students combine information from two or more sources to provide and describe evidence about
 - the positive and negative effects on the environment as a result of human activities.
 - how individual communities can use scientific ideas and a scientific understanding of interactions between components of environmental systems to protect a natural resource and the environment in which the resource is found.

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

Figure 1: 1900 Hurricane Damage



In 1904, the town of Galveston built sea walls along the coast. One concrete sea wall was 3.3 km long, 5 m thick and 4 m high. Sand was used to fill the space behind the sea wall, increasing the height of the island. Rocks were put at the base of the seawall to help with the force of the waves crashing against it.

Figure 2: Galveston Seawall



Grades 3-5 SCIENCE

	<p>The list describes some features of the Galveston seawall:</p> <ul style="list-style-type: none">- The top of the seawall is a trail for hiking and biking.- Fishing piers reach out from the seawall into the Gulf of Mexico.- A beach is located in front of the seawall.- Artists paint murals on the part of the seawall facing the beach. <p>Building a seawall in Galveston has had both positive and negative effects.</p> <ol style="list-style-type: none">1. List one example of a negative effect that the seawall has had on the environment in Galveston. (possible answers: some animals do not have easy access to the beach, the rocks may have destroyed some habitats)2. List one example of a positive effect that the seawall has had on the environment in Galveston. (possible answers: habitats are more protected from the waves and water erosion, vegetation on the island could be spared from the storms)
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Grades 3-5 SCIENCE

Engineering, Technology, and Application of Science		5.ETS1.A.1
Core Idea Component MLS	Engineering Design	
	Defining and Delimiting Engineering Problems	
	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	
<u>Expectation Unwrapped</u>		<u>DOK Ceiling</u> 3
<u>SCIENCE AND ENGINEERING PRACTICES</u> Asking Questions and Defining Problems <ul style="list-style-type: none">Define a simple design problem that can be solved through the development of and object, tool, processes, system and includes several criteria for success and constraints on materials, time, or cost. <u>DISCIPLINARY CORE IDEAS</u> Defining and Delimiting Engineering Problems <ul style="list-style-type: none">Possible solutions to a problem are limited by the available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for cusses or how well each takes the constraints into account. <u>CROSSCUTTING CONCEPTS</u> <ul style="list-style-type: none">N/A		<u>Item Format</u> Selected Response Constructed Response Technology Enhanced
<u>Content Limits/Assessment Boundaries</u> <ul style="list-style-type: none">Students’ descriptions should be limited to a written response. Pictorial descriptions would be possible as part of a technology enhanced item.		<u>Sample Stems</u> The town hall of Greenville was built back in 1915. There are four steps to get up to the entrance of the stone building. When the building was originally built, there were no laws to help out people who had difficulty with stairs. The mayor wants to correct this. He is looking for a way to help people in wheelchairs safely get into the building. He asks the maintenance department to help.
<u>Possible Evidence</u> <ul style="list-style-type: none">Students use given scientific information and information about a situation or phenomenon to define a simple design problem that includes responding to a need or want.		

Grades 3-5 SCIENCE

- The problem students define is one that can be solved with the development of a new or improved object, tool, process, or system.
- Students describe that people's needs and wants change over time.
- Students define the limits within which the problem will be addressed, which include addressing something people want and need at the current time.
- Based on the situation people want to change, students specify criteria (required features) of a successful solution.
- Students describe the constraints or limitations on their design, which may include the following:
 - o Cost
 - o Materials
 - o Time

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

They come up with three plans for the mayor to choose from to remedy the situation.

Construction Proposals			
Plan	Cost	Outcome	Timeframe
A	\$15,000	build a ramp out of stainless steel with handles that is attached with bolts to the stairs	2 weeks
B	\$1,000	build a ramp made out of inexpensive wood that is laid on top of the stairs	2 days
C	\$2,100	build a long ramp so it is not too steep made out of cedar (more expensive wood) and is attached with bolts to the stairs	4 days

Considering that the mayor is on a tight budget and there is a town hall meeting in a week, which of the following proposals should he choose? Give two reasons why he should choose that proposal.

Grades 3-5 SCIENCE

Engineering, Technology, and Application of Science		5.ETS1.B.1
Core Idea Component MLS	Engineering Design Developing Possible Solutions Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	
<u>Expectation Unwrapped</u> <u>SCIENCE AND ENGINEERING PRACTICES</u> Constructing Explanations and Designing Solutions <ul style="list-style-type: none"> Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. <u>DISCIPLINARY CORE IDEAS</u> Developing Possible Solutions <ul style="list-style-type: none"> Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. <u>CROSSCUTTING CONCEPTS</u> <ul style="list-style-type: none"> N/A 		<u>DOK Ceiling</u> 3 <u>Item Format</u> Selected Response Constructed Response Technology Enhanced
<u>Content Limits/Assessment Boundaries</u> <ul style="list-style-type: none"> Students' descriptions should be limited to a written response. Pictorial descriptions would be possible as part of a technology enhanced item. 		<u>Sample Stems</u> A fifth grade class was given the challenge to create a catapult that would launch a marshmallow the farthest distance. The teacher showed the students a picture of a catapult.

Grades 3-5 SCIENCE

Possible Evidence

- Students use grade-appropriate information from research about a given problem, including the causes and effects of the problem and relevant scientific information.
- Students generate at least two possible solutions to the problem based on scientific information and understanding of the problem.
- Students specify how each design solution solves the problem.
- Students share ideas and findings with others about design solutions to generate a variety of possible solutions.
- Students describe the necessary steps for designing a solution to a problem, including conducting research and communicating with others throughout the design process to improve the design. The emphasis is on what is necessary for designing solutions not on a stepwise process.
- Students describe
 - the given criteria (required features) and constraints (limits) for the solutions, including increasing benefits, decreasing risks/costs, and meeting societal demands as appropriate.
 - how the criteria and constraints will be used to generate and test the design solutions.
- Students test each solution under a range of likely conditions and gather data to determine how well the solutions meet the criteria and constraints of the problem.
- Students use the collected data to compare solutions based on how well each solution meets the criteria and constraints of the problem.

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

Figure 1: Catapult



Next, the teacher shared a list of materials available for the student's to make the catapult.

Materials:

- small, thin rubber bands
 - medium, thick rubber bands
 - long, medium thickness rubber bands
 - crafts sticks
 - plastic spoons
 - metal spoons
 - straws
 - toothpicks
 - spaghetti noodles
 - string
 - unsharpened pencils
1. List two items the students should use. Explain why these materials should be used.
 2. List two items the students should not use. Explain why these materials should not be used.

Grades 3-5 SCIENCE

Engineering, Technology, and Application of Science		5.ETS1.C.1
Core Idea	Engineering Design	
Component	Optimizing the Solution Process	
MLS	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	
<u>Expectation Unwrapped</u>		<u>DOK Ceiling</u> 3
<u>SCIENCE AND ENGINEERING PRACTICES</u> Planning and Carrying Out Investigations <ul style="list-style-type: none"> Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials is considered. <u>DISCIPLINARY CORE IDEAS</u> Developing Possible Solutions <ul style="list-style-type: none"> Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. <u>CROSSCUTTING CONCEPTS</u> <ul style="list-style-type: none"> N/A 		<u>Item Format</u> Selected Response Constructed Response Technology Enhanced
<u>Content Limits/Assessment Boundaries</u>		<u>Sample Stems</u>
<ul style="list-style-type: none"> N/A 		Biologists often study animals in remote locations. To help them get needed supplies and food, a group of engineers are designing robots that can travel in unique environments. Below is a chart listing the different types of robots that they have created.
<u>Possible Evidence</u>		
<ul style="list-style-type: none"> Students describe the purpose of the investigation, which includes finding possible failure points or difficulties to identify aspects of a model or prototype that can be improved. Students describe the evidence to be collected, including <ul style="list-style-type: none"> how well the model/prototype performs against the given criteria and constraints. specific aspects of the prototype or model that do not meet one or more of the criteria or constraints (i.e., failure points or difficulties). 		

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- aspects of the model/prototype that can be improved to better meet the criteria and constraints.
- Students describe how the evidence is relevant to the purpose of the investigation.
- Students create a plan for the investigation that describes different tests for each aspect of the criteria and constraints. For each aspect, students describe
 - the specific criterion or constraint to be used.
 - what is to be changed in each trial (the independent variable).
 - the outcome (dependent variable) that will be measured to determine success.
 - what tools and methods are to be used for collecting data.
 - what is to be kept the same from trial to trial to ensure a fair test.
- Students carry out the investigation, collecting and recording data according to the developed plan.

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

Robot Prototypes		
Robot Name	Type of Movement	Other Details
Waterbot	shaped like a boat and moves through the water by its paddles (found under the boat to mimic duck feet)	*cooler for food *bag to put in supplies *short sides are on the boat part *duck feet will walk on land
Sandybot	has wheels like a tank that can move easily through sand	*the top is an enclosed area that has room for a cooler and supplies
Snowybot	has wheels like a tank, but grips the rocks and snow to move easily through mountainous terrain	*the top is enclosed *it is heated using a battery *there is room for supplies and food

A biologist wanted to try the Sandybot because he was studying scorpions in the Sahara Desert.

1. Describe one improvement that the biologists should ask to be made before they use the robot?

Another biologist wanted a robot to use while studying dart frogs in the Amazon Rainforest.

1.
 - a. Identify which robot they should choose to help them get supplies.
 - b. Provide evidence to support your answer to Part A.

